1. Background

This document describes the initial effort to develop the DSN Software Engineering Handbook and provides some guidelines for implementing a program for continuous software process improvement.

2. Goals

The DSN Software Engineering Handbook is to satisfy many goals, some short term, some long term. The goals are presented here in priority order.

1. Provide **useable** processes that address both management and development and that will not be methodology-specific (e.g., OO vs.Structured or Rumbaugh vs. Colbert vs, Yourdon). The processes should reflect common sense application of industry accepted paradigms to the JPL development environment.
2. The processes should recognize differences in projects (e.g., size, complexity, resource availability, risk). Processes should be empirically tested on a project before becoming finalized. Processes should combine both JPL experience and industry concepts, such as those documented in "Managing the Software Process", by Watts Humphrey.
3. A major goal of this documentation process is to reduce dependency upon individual JPL or contractor personnel and, in turn, to reduce the impact of attrition.
4. Encourage application of tools to the development environment. Provide recommendations for tailoring current JPL standards to accomodate new development technology.
5. To help reduce the overall cost, time, and risk of developing and maintaining software. This goal is consistent with NASA's mandate for "faster, better, cheaper, smaller" systems.
6. To document, in a concise fashion, a quality software development process to be applied within JPL's DSN by both JPL and contractor staff. The quality process will be designed to achieve cost and schedule reductions.
7. To reflect different life cycle models (e.g., spiral model, modified waterfall, rapid development, package based development) being used and considered within JPL.
8. To address the software development issues which are adjuncts of or replacements for custom development; e.g., software reuse, package based development.
9. To provide outlines and checklists and process models, de-emphasizing text, for the activities of each stage of development for each life cycle model.
10. To be accessible through Mosaic.
11. To be consistent with D-4000. D-4000 may need tailoring to be consistent with the latest technology and 'best practises'.
12. To simultaneously address the technical, management, and organizational issues of any system or software development effort.
13. To provide the documented framework for an initiative to continuously improve software development and maintenance within the DSN. This framework also includes domain analysis, metrics gathering and analysis and experiments with new tools and techniques.
14. To be flexible enough to always reflect best current practice as identified by:
    - DSN's successful experiments to improve software.
    - The Carnegie Mellon Software Engineering Institute (SEI) Capability Maturity Model (CMM).
    - The University of Maryland's Software Engineering Laboratory (SEL) experience and approach to software improvement.
    - Best practices identified by *benchmarking* other organizations.

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3. Annotated SOW

This is an annotated version of the SOW for CWO 23. The annotations reflect the ISDS team understanding of the SOW items. The ISDS team has added annotations, clarifications, and interpretations in *italics*. Individual words inserted into the SOW text are designated by *[brackets]* in *italics*. Requests for clarification are designated by ***RFC:***.

3.1 GUIDELINES, CONSTRAINTS, and ASSUMPTIONS

- This Statement of Work is used for the creation of a DSN Electronic Software Engineering Handbook.
- The Handbook shall be consistent with JPL D-4000 standards, TDA Standard Practice TDA 810 series, and the TDA 813 Series document.
- JPL will provide copies of D-4000 standards, TDA standard 810 series, TDA standard 813 series, and computer resource for Mosaic file.

  ISDS has copies of D-4000 standards.
- JPL will provide consulting and expertise related to JPL D-4000, TDA 810, and TDA 813.
- JPL will provide monthly reviews and feedback to this CWO.

  JPL will identify the review team by 1 March 1995.

  These are structured but informal , scheduled reviews. See Section 3.3, item 2 for the way ISDS would like to work to maximize benefit for the resources expended.
- *JPL will provide meeting and conference review and rollout activities.*

3.2 WORK TO BE PERFORMED

- Generation of a DSN Electronic Software Engineering Handbook to include, but not be limited, to the following items:
  - The Subsystem/Assembly Development Process Model
  - Process Improvement Approach
  - Software Development Environment (SDE) Description
  - Common Software (CSW) Library Description
  - Software Project Planning
  - Software Requirements *[Analysis and tracking]*
  - Software Architecture Design
  - Software *[Implementation]* (Development)
  - *[Developer]* Test and Integration
  - *[Assembly, Subsystem, & System]* Testing and Delivery
- Each item shall include, but not be limited to, the following:
  - Pre-conditions *[Entry criteria]*
  - Activity Performed Steps
  - Rapid Prototype
  - Measurement and Analysis
  - Verified Implementation/Defect Prevention
  - Relationship with Reviews
  - *Post-conditions [Exit criteria]*
  - Lessons learned from past DSN software development process *[and capturing the lessons learned in this effort]*

3.3 IMPLEMENTATION SCHEDULE

1. Produce a Work Implementation Plan (WIP) for the task defined in this Statement of Work which includes a detailed schedule for the delivery of items.

   The WIP will be a minimal interpretation to convey the necessary information and agreements to the participants.

   The detailed schedule does not need to be very detailed until the outline is finalized. The WIP is a living document that grows as detail is needed (provided). It is always comprehensive; small at the outset, but correspondingly large by the end of the project.

2. Report the results of the CWO monthly to JPL for review and feedback.

   We view review as a constant, ongoing, and, in some cases, daily process. The monthly report would sumarize the results for the reporting period, highlighting progress and problem areas where management assistance or decisions are required. Reports to management may be required prior to the end of the month on an exception basis.

   We would like more frequent review and feedback because we will be taking an iterative approach; i.e., write a little, review a little, deliver a little. Under this approach, we would start with a skeleton and add on to it piece-wise. As each piece or group of pieces was added or changed, we would notify the reviewers by EMAIL and solicit both review and feedback. We want most of the feedback to be EMAIL to minimize review delays.

   Such a development approach requires that CM support easy update while providing controlled updates and tracking of versions. For example, we would want each section to be annotated with author, generation date, and status.

3. Draft outlines by 3/15/95.

   We already have a draft outline which needs refining.

4. Provide electronic documentation by 7/15/95.

   There is no requirement for a paper document to be produced. The document will be delivered in Mosaic form; i.e., as a series of HTML files.

   ***RFC:** Should checklists, tables of content for documents, agendas, be available in alternate forms (e.g., printable from the mosaic screen, μ Soft Word style sheet)?*

   Because the document will consist of a series of HTML files, we would like the delivery to be electronic to wherever the final destination is (probably a machine controlled by SPMC). This delivery approach minimizes the delivery effort, only requiring a delivery letter explaining how to transfer the files.

5. Provide final Handbook demonstration by 9/17/95.

   This is a beginning of a 'rollout activity' beginning about 15 August and continuing to 17 September as a series of demos to various audiences. Rollout discussion is in section 4. The handbook will never be finished. But it will be in use by April, 95 and will continually grow and be revised as requirted by this CWO and future practise. It should be as brief as possible, but as detailed as necessary to get the job done. The philosophy is to apply an idea or two and get it (them) working before implementing the next concept (not necessarily a new idea, but one which hasn't been

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formally applied to the JPL environment).

4. Rollout and Continuous Software Process Improvement

The complete rollout activity begins to (employ, embed, install, implant, instantiate) the handbook, its methods and tools, into the larger JPL DSN organization. The long term activity assures that the software development processes evolve with technology and methodology.

4.1 Initial Rollout

Initial rollout includes:

- Give introductory presentations to a broad audience of JPL staff and contractors. This is the only part of rollout included in the SOW. This should consist of a formal oral presentation, introduced by JPL senior management (Chris Carl or higher to indicate their unequivocal support).
- Pick some representative tasks, CWOs, projects, and instantiate the use of the handbook in them. This process involves:
  - Training each team
  - Helping the team appropriately apply the Handbook to their specific needs; e.g., rapid prototype for proof-of-concept is different from developing operational DSN software.

4.2 The Long Term -- Broad Deployment and Continuous Improvement

This activity is outside the scope of the CWO. It is included to help define the content and goals of the initial effort. This effort assumes an approach based on the Software Engineering Laboratory approach, a joint activity of the University of Maryland, Goddard Space Flight Center, and CSC. The handbook will, as a self-fullfilling prophecy, provide for it's own improvement over time will actas an instrument for managing change.

- As new projects, tasks, CWOs are identified, assure that the handbook is used for them through training and application support.
- Evaluate the techniques, processes, tools, and checklists for effectiveness and applicability.
- Conduct experiments (i.e., small efforts using new or altered tools) to identify potential improvements.
- Include the results of successful experiments in the handbook.